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## (54) CONTROL METHOD FOR MULTI-ROBOT SYSTEM

(57)Abstract:

PURPOSE: To use a track in common, to avoid collision of respective robots by a simple control system and to prevent the practical interruption of the command operation of the respective robots in a multi-robot system in which many individually controlled robots travel.

CONSTITUTION: When the approach of a first robot camera R1 operated corresponding to a command information A for sampling information to be supplied to a client (a) and a second robot camera R2 operated corresponding to the command information B for sampling the information to be supplied to the client (b) is detected in an approach sensor 7, a command information changeover processing for supplying the command information A to the second robot camera R2 and simultaneously supplying the command information B to the first robot camera R1 and sampling information changeover for changing video signals from the first robot camera R1 to the ones for the client (b) and simultaneously changing the video signals from the second robot camera R2 to the ones for the client (a) are processed in relation.
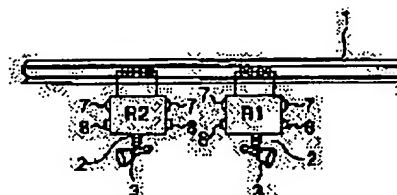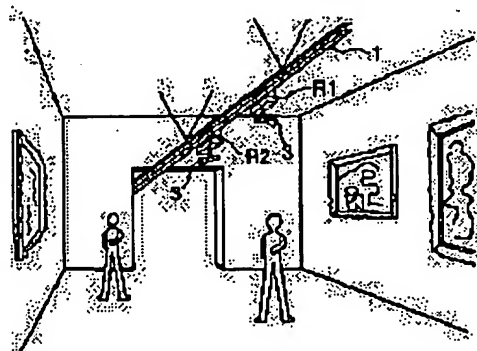
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## TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] It is necessary to make many robots controlled by many operators according to an individual not compete on an orbit (rail) in the multi-robot system mentioned above. That is, it is troubled by the ability of the activity which the robot with which the transit direction differs from a rate collided on the orbit, therefore was ordered, respectively not to be done.
[0006] Then, two or more orbits are installed, the centralized control of each robot's location, or the transit direction and a rate is carried out, a certain robot's transit path is suitably chosen by relation with other surrounding robots' run state, and the system it is made to run as a command can be considered, avoiding robots' collision. However, there is a trouble of many following in this case.
[0007] First, an orbital facility complicates forming the point which installs two or more orbits and changes a transit path etc., and it becomes an expensive rank, and the abnormalities in transit and failure also tend to break out in a point part etc. If there are many robots overwhelmingly, in order to avoid a collision to the installed number of orbits, the measure of stopping some robots is required, then many opportunities for a robot not to move as an operator's command occur.
[0008] moreover , as a control system for carry out the centralized control of each robot location , or the transit direction and a rate , and choose each robot transit path , the high efficiency more than the centralized control system of the train currently employ by JR etc. be require ( since it do not know how many robots of this system move unlike the train by which operation management be carry out with the diamond ) , and the implementation take a great effort and time amount at a software development . Great cost also starts the hardware of the sensor system for getting to know each robot's location, transit direction, and rate in a detail again. In addition, it is also a big problem that it cannot be diverted to the alien system from which an orbital layout differs even if it develops software to the robot camera systems of a certain art gallery.
[0009] It is in offering the control approach that purpose is [ approach ] the multi-robot system the robot of a large number by which individial control is carried out runs, communalize [ approach ] an orbit, and moreover avoid [ approach ] a collision of each robot with an easy control system by having made this invention in view of the conventional trouble mentioned above, and it was made not to interrupt a command of each robot substantially.

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[Translation done.]

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EXAMPLE

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[Example] The rough introspection of the art gallery which applied the multi-robot system of this invention is shown in drawing 1 , and the overall outline of that system configuration is shown in drawing 3 . Like drawing 1 , one rail 1 was spread around head lining of an art gallery along with the admiration course, and it has equipped with two or more robot cameras Rn (n= 1, 2, -- i) so that it may hang down from the rail 1. Each robot camera Rn is controlled according to an individual, and runs along with a rail 1.
[0021] As shown in drawing 2 , the Hi-Vision television camera 3 is carried in each robot camera Rn through the universal head 2 by which servo control is carried out. Exhibits, such as pictures and sculpture, are photoed with this television camera 3, and that video signal is transmitted to each client through the CC section 4, and it projects on the television set 5 currently installed in the client side, and admires. The controller 6 of a robot camera attaches to the television set 5 of each client.
[0022] The system configuration of each robot camera Rn is shown in drawing 4 . As shown in this drawing 4 and drawing 2 , the approach sensor 7 equivalent to the above-mentioned approach detection means is arranged in the front face and tooth back of a body of a robot camera Rn. This uses proximity sensors, such as electromagnetic or a photoelectrical type. If two sets of robot cameras approach below fixed distance, the detecting signal of the approach sensor 7 of both robot cameras will serve as ON, respectively. Moreover, the connector 8 between robots is also arranged in the front face and tooth back of a body of a robot camera Rn. When two sets of robot cameras contact, it joins mutually together, and the signal transmission of this connector 8 becomes possible mutually through both connectors 8. Moreover, when connector 8 comrades join together, the robot control section 9 in two sets of robot cameras acquires a specific logic signal from a specific connector pin, and the signal is used as a contact detection signal of robot cameras.
[0023] As shown in drawing 4 , each robot camera Rn is equipped with the transit mechanical component 10 which a rail 1 is met [ mechanical component ], and moves forward or retreats a robot at a rate suitably, the azimuth mechanical component 11 which changes the azimuth of a television camera 3, the inclination mechanical component 12 which changes the inclination of a television camera 3, and the zoom mechanical component 13 which changes the focal distance of the taking lens of a television camera 3. Servo control of each [ these ] mechanical components 10-13 is carried out by the robot control section 9.
[0024] It combined with the data transmission line which leads to the CC section 4 through the transmission control section 14, and the robot control section 9 has combined the video-signal output system of a television camera 3 with the data transmission line which leads to the CC section 4 through the transmission control section 15. As the data transmission line which combines each robot camera Rn and the CC section 4, the wired system using a rail 1 may be used, and the radio system using laser, infrared radiation, etc. may be used.
[0025] Moreover, each client and the CC section 4 are combined by the exclusive digital circuit using a public digital circuit, optic fiber communications, and satellite communication, such as ISDN. From the controller 6 which the operator of a client side operates, the command information for carrying out servo control of transit mechanical-component 10, azimuth mechanical-component 11, inclination mechanical-component 12, and the zoom mechanical component 13 in a robot camera Rn occurs, and this is transmitted to the CC section 4 through said data transmission line, and is told to one set of a predetermined robot camera by the CC section 4. This command information is told to the robot control section 9 from the transmission control section 14, and servo control of each mechanical components 10-13 is carried out according to that command information. Moreover, by opposite data flow, the video signal from a television camera 3 is transmitted to the CC section 4 from the transmission control section 15, and is further supplied to the television set 5 of a

predetermined client from the CC section 4.

[0026] In a controller 6, in relation to the transit mechanical component 10, there are an advance carbon button, a retreat carbon button, and an earth switch, and there are an accelerating carbon button and a moderation carbon button. Moreover, in relation to azimuth mechanical-component 11, elevation angle mechanical-component 12, and the zoom mechanical component 13, there are a (+) carbon button and a (-) carbon button, respectively. The input signal of these carbon buttons of a controller 6 is told to the robot control section 9, and the robot control section 9 generates the servo control signal of each mechanical components 10-13 from the signal, and gives each part. Advance, retreat, a halt, accelerating, and moderation of robot transit are controlled by this, and the increment and decrement of a variation rate of a camera are controlled. [ of an azimuth, an elevation angle, and a zoom ]

[0027] In performing such servo control, while the information on the newest controlled variable given to each mechanical components 10-13 is updated by the servo information memory 16 of the robot control section 9, it memorizes. When two sets of robot cameras contact, it is exchanged through said connector 8 in the information on the newest controlled variable stored in memory 16 so that it may explain below.

[0028] Control action when two sets of robot cameras R1 and R2 next become that it is likely to collide on a rail 1 is explained in order according to the flow chart of drawing 5 and drawing 6 .

[0029] First, a robot camera R1 presupposes that it is used by Client a and the robot camera R2 is used by Client b. That is, according to the command information A generated from the controller 6 of Client a, servo control of the robot camera R1 was carried out, and the video signal from this camera R1 has projected on the television set 5 of Client a. On the other hand according to the command information B generated from the controller 6 of Client b, servo control of the robot camera R2 was carried out, and the video signal from this camera R2 has projected on the television set 5 of Client b.

[0030] And the case where the robot camera R2 with which the robot camera R1 is moving forward at high speed, and is moving forward a that front at a low speed, for example is approached gradually is assumed. While the robot control section 9 of each robot camera Rn is performing supervisory control shown in the flow chart of drawing 5 , the CC section 4 is performing supervisory control shown in the flow chart of drawing 6 .

[0031] If two sets of robot cameras R1 and R2 approach below predetermined spacing, the output of each approach sensor 7 will be turned on. In response to this signal, it turns out that another robot camera is approaching the front or back, and both the robot control section 9 notifies that to the CC section 4 (step 500->501). The CC section 4 waits for the notice of contact from both the robot control section 9, making preparations of 1, the command information change processing betweenRrobot camera R2, and video-signal change processing in response to the notice of approach from both the robot control section 9 (step 600->601->602).

[0032] Moreover, both the robot control section 9 performs braking control at step 502, in order to avoid that robot cameras R1 and R2 collide violently, after issuing the aforementioned notice of approach. This braking control is performed by reducing that advanced speed compulsorily in the near robot camera R1 which is approaching at the high speed of the robot cameras R1 and R2. It waits to check the signal from a connector 8, performing braking control, and for robot cameras R1 and R2 to contact (step 503).

[0033] Furthermore, both the robot control section 9 exchanges mutually the newest controlled-variable information stored in each servo information memory 16 through the united connector 8 while notifying that to the CC section 4 (step 504), if a contact detection signal is acquired from a connector 8 (step 505). It means exchanging now the parameter which shows the current operating state of each mechanical components 10-13 by two sets of robot cameras R1 and R2.

[0034] Moreover, in the CC section 4, change processing of command information and change processing of a video signal are performed in response to the aforementioned notice of contact about robot cameras R1 and R2 and Clients a and b (step 603->604). That is, the command information A generated from the controller 6 of Client a is supplied to a robot camera R2, servo control of the robot camera R2 is carried out according to the command information A, and the video signal from this camera R2 projects on the television set 5 of Client a. The command information B generated from the controller 6 of Client b is supplied to a robot camera R1, servo control of the robot camera R1 is carried out to coincidence according to the command information B, and the video signal from this camera R1 projects on the television set 5 of Client b.

[0035] Thus, a role will interchange [ robot cameras R1 and R2 ], a robot camera R1 will be used by Client b, and a robot camera R2 will be used by Client a. And the continuity of the actuation accompanying substitution of a role is maintained mostly, and derangement of transitional actuation is very slight.

[0036]

[Translation done.]

CLAIMS

[Claim(s)]
[Claim 1] The control approach of the multi-robot system characterized by having each following requirement for configuration ** - **.
** Two or more robots carrying the sensors for information extraction run in accordance with a common orbit.
** Each robot operates according to the command information on the time series given according to an individual from the CC section, and the transit direction and travel speed on said orbit are controlled according to an individual.
** The extraction information extracted by each robot is supplied to the appointed client, respectively.
** There is an approach detection means to detect that two robots approached on said orbit and both spacing became below predetermined.
** With the 1st robot which is extracting the information which is operating according to the command information A and is supplied to Client a When approach with the 2nd robot which is extracting the information which is operating according to the command information B and is supplied to Client b is detected by said approach detection means Command information change processing in which the command information B is given to the 1st robot at the same time it gives the 2nd robot the command information A, It is related and extraction information change processing in which the extraction information by the 2nd robot is changed for client a is performed at the same time it changes the extraction information by the 1st robot for client b.
[Claim 2] It is the control approach of the multi-robot system characterized by combining each robot and said approach detection means with said CC section by the data transmission line in claim 1, and said CC section performing said command information change processing and said extraction information change processing following the detecting signal of said approach detection means.
[Claim 3] The control approach of the multi-robot system characterized by to exchange the data which prepare the connector each other combined possible [ signal transfer ] in claim 1 when two robots contact each robot on said orbit , and are needed with said command information change processing or said extraction information change processing through said connector among the robots which contacted .
[Claim 4] The control approach of the multi-robot system characterized by performing said command information change processing and said extraction information change processing by these two robots side by exchanging necessary data through said connector in claim 3 between two robots which contacted.
[Claim 5] The control approach of the multi-robot system characterized by performing braking control which has priority over the command information given to both robots, and makes both robots' relative velocity small gradually by both both both [ one side or ], and contacting both robots with crawling in either of claims 1-4 when approach of two robots is detected by said approach detection means.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention equips the rail of head lining of an art gallery or a museum with many robot cameras free [ transit ], and relates to the control approach in the case of making it run two or more robots at the direction and rate of arbitration along with a common rail especially about a multi-robot system which supplies the image from each camera to many clients.
[0002]
[Description of the Prior Art] The following application systems are proposed with progress of the multimedia technique based on a high definition television like Hi-Vision, optic fiber communication, a high efficiency data compression, etc. It is a system which inspects and admires the exhibit of an art gallery or a museum etc. freely with a high definition television at a home, for example.
[0003] This system is realizable with the following means. The rail a robot camera runs on the head lining of an art, gallery is spread around. The robot camera carried in the rail runs inside of a hall freely because the admiration person who is present in a home operates a controller, and remote control of sense, zooming, etc. of a camera is carried out by said controller. The video signal photoed with this camera is transmitted to the television set which the operator of said controller is watching. This configuration itself is the robot camera system currently used widely in the television station etc. This was spread through individual level with the multimedia technique, while the physically handicapped person and the man of a remote place were in the house and operated said controller, television was watched, and the system which can enjoy an image which he walked along the inside of an art gallery, and has been admired as the time is planned.
[0004] If it explains according to the aforementioned example in such application, the multiple system that equip many robot cameras in the art gallery, and the man of a large number which are present in various locations does remote control of the robot camera through a communication line, respectively, and receives the image of the camera which he controls, respectively on familiar television through a communication line will be the requisite. This is the example of an outline of the multi-robot system set as the object of this invention, and, below, those who do remote control of the robot are made to call it a client for a remote operator or the informational (the aforementioned example image of a camera) sink device only extracted by the operator, and a call and a robot. Said controller and client which an operator operates correspond as mentioned above.
[0005]
[Problem(s) to be Solved by the Invention] It is necessary to make many robots controlled by many operators according to an individual not compete on an orbit (rail) in the multi-robot system mentioned above. That is, it is troubled by the ability of the activity which the robot with which the transit direction differs from a rate collided on the orbit, therefore was ordered, respectively not to be done.
[0006] Then, two or more orbits are installed, the centralized control of each robot's location, or the transit direction and a rate is carried out, a certain robot's transit path is suitably chosen by relation with other surrounding robots' run state, and the system it is made to run as a command can be considered, avoiding robots' collision. However, there is a trouble of many following in this case.
[0007] First, an orbital facility complicates forming the point which installs two or more orbits and changes a transit path etc., and it becomes an expensive rank, and the abnormalities in transit and failure also tend to break out in a point part etc. If there are many robots overwhelmingly, in order to avoid a collision to the installed number of orbits, the measure of

stopping some robots is required, then many opportunities for a robot not to move as an operator's command occur.
[0008] moreover , as a control system for carry out the centralized control of each robot location , or the transit direction and a rate , and choose each robot transit path , the high efficiency more than the centralized control system of the train currently employ by JR etc. be require ( since it do not know how many robots of this system move unlike the train by which operation management be carry out with the diamond ) , and the implementation take a great effort and time amount at a software development . Great cost also starts the hardware of the sensor system for getting to know each robot's location, transit direction, and rate in a detail again. In addition, it is also a big problem that it cannot be diverted to the alien system from which an orbital layout differs even if it develops software to the robot camera systems of a certain art gallery.
[0009] It is in offering the control approach that purpose is [ approach ] the multi-robot system the robot of a large number by which individial control is carried out runs, communalize [ approach ] an orbit, and moreover avoid [ approach ] a collision of each robot with an easy control system by having made this invention in view of the conventional trouble mentioned above, and it was made not to interrupt a command of each robot substantially.
[0010]
[Means for Solving the Problem] The control approach of the multi-robot system this invention is characterized by having following requirements for configuration ** - **.
[0011] ** Two or more robots carrying the sensors for information extraction run in accordance with a common orbit.
[0012] ** Each robot operates according to the command information on the time series given according to an individual from the CC section, and the transit direction and travel speed on said orbit are controlled according to an individual.
[0013] ** The extraction information extracted by each robot is supplied to the appointed client, respectively. ** There is an approach detection means to detect that two robots approached on said orbit and both spacing became below predetermined.
[0014] ** With the 1st robot which is extracting the information which is operating according to the command information A and is supplied to Client a When approach with the 2nd robot which is extracting the information which is operating according to the command information B and is supplied to Client b is detected by said approach detection means Command information change processing in which the command information B is given to the 1st robot at the same time it gives the 2nd robot the command information A, It is related and extraction information change processing in which the extraction information by the 2nd robot is changed for client a is performed at the same time it changes the extraction information by the 1st robot for client b.
[0015] In the aforementioned control approach, it combines with said CC section by the data transmission line, and each robot and said approach detection means can take how said CC section performs said command information change processing and said extraction information change processing following the detecting signal of said approach detection means.
[0016] Moreover, in the aforementioned control approach, when two robots contact each robot on said orbit, the connector each other combined possible [ signal transfer ] is prepared, and the data which are needed with said command information change processing or said extraction information change processing can be exchanged through said connector among the robots which contacted. In this case, it is exchanging necessary data through said connector between two robots which contacted, and said command information change processing and said extraction information change processing can be performed by these two robots side.
[0017] Moreover, in the aforementioned control approach, when approach of two robots is detected by said approach detection means, it is desirable to take the approach of performing braking control which has priority over the command information given to both robots, and makes both robots' relative velocity small gradually by both both both [ one side or ], and contacting both robots with crawling.
[0018]
[Function] While the 1st robot is moving forward the orbit top slowly according to the command information A (the information extracted by this 1st robot is supplied to Client a), according to the command information B, the 2nd robot moves forward at high speed, and presupposes the same orbit top that this is approached from the 1st robot's back (the information extracted by this 2nd robot is supplied to Client b). And if the 2nd robot which moves forward at high speed approaches the 1st robot which precedes at a low speed to point-blank range, that will be detected by said approach detection means and said command information change processing and said extraction information change processing will be performed. Consequently, the 1st robot with which it caught up by preceding operates according to the command

information B, the 2nd robot which came to move forward at high speed and caught up operates according to the command information A, and it comes to move forward at a low speed. Moreover, the 1st robot's extraction information is supplied to Client b, and the 2nd robot's extraction information is supplied to coincidence at Client a. That is, the role of the 1st robot and the 2nd robot interchanges, and it runs the separate orbit top in which two robots were installed side by side when seen from both the clients that are operating two robots, respectively at the rate of arbitration, and becomes as the same as the high-speed robot passed the low-speed robot of precedence afterwards.

[0019] When the 2nd robot has approached the 1st robot which has stopped on an orbit, or also when the 1st robot which is moving forward, and the 2nd robot which is retreating become colliding, both robots' role will interchange like the above and actuation of the robot which saw from the client side will be continued.

[0020]

[Example] The rough introspection of the art gallery which applied the multi-robot system of this invention is shown in drawing 1 , and the overall outline of that system configuration is shown in drawing 3 . Like drawing 1 , one rail 1 was spread around head lining of an art gallery along with the admiration course, and it has equipped with two or more robot cameras Rn (n= 1, 2, -- i) so that it may hang down from the rail 1. Each robot camera Rn is controlled according to an individual, and runs along with a rail 1.

[0021] As shown in drawing 2 , the Hi-Vision television camera 3 is carried in each robot camera Rn through the universal head 2 by which servo control is carried out. Exhibits, such as pictures and sculpture, are photoed with this television camera 3, and that video signal is transmitted to each client through the CC section 4, and it projects on the television set 5 currently installed in the client side, and admires. The controller 6 of a robot camera attaches to the television set 5 of each client.

[0022] The system configuration of each robot camera Rn is shown in drawing 4 . As shown in this drawing 4 and drawing 2 , the approach sensor 7 equivalent to the above-mentioned approach detection means is arranged in the front face and tooth back of a body of a robot camera Rn. This uses proximity sensors, such as electromagnetic or a photoelectrical type. If two sets of robot cameras approach below fixed distance, the detecting signal of the approach sensor 7 of both robot cameras will serve as ON, respectively. Moreover, the connector 8 between robots is also arranged in the front face and tooth back of a body of a robot camera Rn. When two sets of robot cameras contact, it joins mutually together, and the signal transmission of this connector 8 becomes possible mutually through both connectors 8. Moreover, when connector 8 comrades join together, the robot control section 9 in two sets of robot cameras acquires a specific logic signal from a specific connector pin, and the signal is used as a contact detection signal of robot cameras.

[0023] As shown in drawing 4 , each robot camera Rn is equipped with the transit mechanical component 10 which a rail 1 is met [ mechanical component ], and moves forward or retreats a robot at a rate suitably, the azimuth mechanical component 11 which changes the azimuth of a television camera 3, the inclination mechanical component 12 which changes the inclination of a television camera 3, and the zoom mechanical component 13 which changes the focal distance of the taking lens of a television camera 3. Servo control of each [ these ] mechanical components 10-13 is carried out by the robot control section 9.

[0024] It combined with the data transmission line which leads to the CC section 4 through the transmission control section 14, and the robot control section 9 has combined the video-signal output system of a television camera 3 with the data transmission line which leads to the CC section 4 through the transmission control section 15. As the data transmission line which combines each robot camera Rn and the CC section 4, the wired system using a rail 1 may be used, and the radio system using laser, infrared radiation, etc. may be used.

[0025] Moreover, each client and the CC section 4 are combined by the exclusive digital circuit using a public digital circuit, optic fiber communications, and satellite communication, such as ISDN. From the controller 6 which the operator of a client side operates, the command information for carrying out servo control of transit mechanical-component 10, azimuth mechanical-component 11, inclination mechanical-component 12, and the zoom mechanical component 13 in a robot camera Rn occurs, and this is transmitted to the CC section 4 through said data transmission line, and is told to one set of a predetermined robot camera by the CC section 4. This command information is told to the robot control section 9 from the transmission control section 14, and servo control of each mechanical components 10-13 is carried out according to that command information. Moreover, by opposite data flow, the video signal from a television camera 3 is transmitted to the CC section 4 from the transmission control section 15, and is further supplied to the television set 5 of a predetermined client from the CC section 4.

[0026] In a controller 6, in relation to the transit mechanical component 10, there are an advance carbon button, a retreat

carbon button, and an earth switch, and there are an accelerating carbon button and a moderation carbon button. Moreover, in relation to azimuth mechanical-component 11, elevation angle mechanical-component 12, and the zoom mechanical component 13, there are a (+) carbon button and a (-) carbon button, respectively. The input signal of these carbon buttons of a controller 6 is told to the robot control section 9, and the robot control section 9 generates the servo control signal of each mechanical components 10-13 from the signal, and gives each part. Advance, retreat, a halt, accelerating, and moderation of robot transit are controlled by this, and the increment and decrement of a variation rate of a camera are controlled. [ of an azimuth, an elevation angle, and a zoom ]

[0027] In performing such servo control, while the information on the newest controlled variable given to each mechanical components 10-13 is updated by the servo information memory 16 of the robot control section 9, it memorizes. When two sets of robot cameras contact, it is exchanged through said connector 8 in the information on the newest controlled variable stored in memory 16 so that it may explain below.

[0028] Control action when two sets of robot cameras R1 and R2 next become that it is likely to collide on a rail 1 is explained in order according to the flow chart of drawing 5 and drawing 6 .

[0029] First, a robot camera R1 presupposes that it is used by Client a and the robot camera R2 is used by Client b. That is, according to the command information A generated from the controller 6 of Client a, servo control of the robot camera R1 was carried out, and the video signal from this camera R1 has projected on the television set 5 of Client a. On the other hand according to the command information B generated from the controller 6 of Client b, servo control of the robot camera R2 was carried out, and the video signal from this camera R2 has projected on the television set 5 of Client b.

[0030] And the case where the robot camera R2 with which the robot camera R1 is moving forward at high speed, and is moving forward a that front at a low speed, for example is approached gradually is assumed. While the robot control section 9 of each robot camera Rn is performing supervisory control shown in the flow chart of drawing 5 , the CC section 4 is performing supervisory control shown in the flow chart of drawing 6 .

[0031] If two sets of robot cameras R1 and R2 approach below predetermined spacing, the output of each approach sensor 7 will be turned on. In response to this signal, it turns out that another robot camera is approaching the front or back, and both the robot control section 9 notifies that to the CC section 4 (step 500->501). The CC section 4 waits for the notice of contact from both the robot control section 9, making preparations of 1, the command information change processing betweenRrobot camera R2, and video-signal change processing in response to the notice of approach from both the robot control section 9 (step 600->601->602).

[0032] Moreover, both the robot control section 9 performs braking control at step 502, in order to avoid that robot cameras R1 and R2 collide violently, after issuing the aforementioned notice of approach. This braking control is performed by reducing that advanced speed compulsorily in the near robot camera R1 which is approaching at the high speed of the robot cameras R1 and R2. It waits to check the signal from a connector 8, performing braking control, and for robot cameras R1 and R2 to contact (step 503).

[0033] Furthermore, both the robot control section 9 exchanges mutually the newest controlled-variable information stored in each servo information memory 16 through the united connector 8 while notifying that to the CC section 4 (step 504), if a contact detection signal is acquired from a connector 8 (step 505). It means exchanging now the parameter which shows the current operating state of each mechanical components 10-13 by two sets of robot cameras R1 and R2.

[0034] Moreover, in the CC section 4, change processing of command information and change processing of a video signal are performed in response to the aforementioned notice of contact about robot cameras R1 and R2 and Clients a and b (step 603->604). That is, the command information A generated from the controller 6 of Client a is supplied to a robot camera R2, servo control of the robot camera R2 is carried out according to the command information A, and the video signal from this camera R2 projects on the television set 5 of Client a. The command information B generated from the controller 6 of Client b is supplied to a robot camera R1, servo control of the robot camera R1 is carried out to coincidence according to the command information B, and the video signal from this camera R1 projects on the television set 5 of Client b.

[0035] Thus, a role will interchange [ robot cameras R1 and R2 ], a robot camera R1 will be used by Client b, and a robot camera R2 will be used by Client a. And the continuity of the actuation accompanying substitution of a role is maintained mostly, and derangement of transitional actuation is very slight.

[0036]
[Effect of the Invention] In the multi-robot system with which many robots controlled according to an individual run the same orbit top according to this invention If two robots which are operating according to a separate control command

become that it is likely to collide on an orbit If it sees from the client side which said command information change processing and said extraction information change processing were performed, and two robots' role interchanged, gave command information to the robot, respectively, and has received a robot's extraction information Two robots continue actuation as a command, respectively, and can transmit continuously the extraction information which the client is demanding to a client.

[0037] Therefore, in order to avoid robots' collision, compared with the system which installs two or more orbits in the same root side by side, and carries out a point change, it is far easy, and an orbital facility and its control system become cheap, and it becomes what has high dependability of operation. Moreover, since it is the system which performs the aforementioned command information change processing and extraction information change processing following the detecting signal of said approach detection means, as for a complicated and advanced control function like the centralized control system of a train, unnecessary therefore, the hardware and software of a control system are easy and cheap, and end. And a collision of the robot which does not know how it is controlled by such easy control system according to an individual, and moves by it is appropriately avoidable.

[0038] If it constitutes so that the aforementioned command information change processing and extraction information change processing may be performed in said CC section, the configuration of the hardware by the side of each robot and software will become easy. Moreover, if it constitutes so that said connector may be prepared and a part or all of command information change processing and extraction information change processing may be performed by each robot side, the configuration of said CC section becomes easy, and the transient at the time of a change can be controlled good. Of course, the mechanical damage accompanying a collision can be prevented almost completely by braking two robots appropriately and making it contact them with crawling.

[Translation done.]

**\* NOTICES \***

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

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## EFFECT OF THE INVENTION

[Effect of the Invention] In the multi-robot system with which many robots controlled according to an individual run the same orbit top according to this invention If two robots which are operating according to a separate control command become that it is likely to collide on an orbit If it sees from the client side which said command information change processing and said extraction information change processing were performed, and two robots' role interchanged, gave command information to the robot, respectively, and has received a robot's extraction information Two robots continue actuation as a command, respectively, and can transmit continuously the extraction information which the client is demanding to a client.

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[Translation done.]

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## MEANS

[Means for Solving the Problem] The control approach of the multi-robot system this invention is characterized by having following requirements for configuration ** - **.

[0011] ** Two or more robots carrying the sensors for information extraction run in accordance with a common orbit.

[0012] ** Each robot operates according to the command information on the time series given according to an individual from the CC section, and the transit direction and travel speed on said orbit are controlled according to an individual.

[0013] ** The extraction information extracted by each robot is supplied to the appointed client, respectively. ** There is an approach detection means to detect that two robots approached on said orbit and both spacing became below predetermined.

[0014] ** With the 1st robot which is extracting the information which is operating according to the command information A and is supplied to Client a When approach with the 2nd robot which is extracting the information which is operating according to the command information B and is supplied to Client b is detected by said approach detection means Command information change processing in which the command information B is given to the 1st robot at the same time it gives the 2nd robot the command information A, It is related and extraction information change processing in which the extraction information by the 2nd robot is changed for client a is performed at the same time it changes the extraction information by the 1st robot for client b.

[0015] In the aforementioned control approach, it combines with said CC section by the data transmission line, and each robot and said approach detection means can take how said CC section performs said command information change processing and said extraction information change processing following the detecting signal of said approach detection means.

[0016] Moreover, in the aforementioned control approach, when two robots contact each robot on said orbit, the connector each other combined possible [ signal transfer ] is prepared, and the data which are needed with said command information change processing or said extraction information change processing can be exchanged through said connector among the robots which contacted. In this case, it is exchanging necessary data through said connector between two robots which contacted, and said command information change processing and said extraction information change processing can be performed by these two robots side.

[0017] Moreover, in the aforementioned control approach, when approach of two robots is detected by said approach detection means, it is desirable to take the approach of performing braking control which has priority over the command information given to both robots, and makes both robots' relative velocity small gradually by both both both [ one side or ], and contacting both robots with crawling.

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[Translation done.]